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ABSTRACT

Described herein are the activities of the Southwest Region Educational Computer Network (SRECN) which was established under funding from the National Science Foundation to provide, via a network, remote computing services to institutions lacking adequate facilities. The report details how SRECN sought to develop the teaching of computer science at participating institutions, to modify and augment the curriculum at each school to incorporate computing methods in established disciplines, and to develop and implement the hardware, communications and computer software essential to the first two objectives. It describes the hardware and central facility of the project and the languages, operating system, remote terminal system and communications used. The library and utility programs are detailed, along with the services, operating schedules, network instructional activities, training programs for faculty and costs. In addition, there are included from each participating institution an evaluation of its experience, a description of the hardware and service it employed and an enumeration of the courses which used network services. (PB)

ED 077234

SOUTHWEST REGION EDUCATIONAL COMPUTER NETWORK

FINAL REPORT
1969-1972

"there has been a significant awakening to the general impact of computers on the teaching-learning process"

EM 011 155

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by

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NSF Grant GJ-741

In Behalf Of

The University of Texas at Austin
Abilene Christian College
Angelo State University
Austin Independent School District
Huston-Tillotson College
Rice University
St. Edward's University
St. Stephen's Episcopal School
Southwest Texas State University
Southwestern University
Texas Lutheran College
Texas Southern University
Trinity University

Abstract

This report covers the cooperative activities of eleven four-year colleges and universities and three secondary schools during the final year of the three-year Southwest Region Educational Computer Network experiment. The Network is served by a CDC 6600/6400 computer system based at the Computation Center of The University of Texas at Austin.

The objectives were to

(1) develop and extend the teaching of computer science at the participating institutions,

(2) modify and augment the curriculum of each participating institution to incorporate computing methods in established disciplines,

(3) develop, implement and utilize the hardware, communications, and computer software essential to accomplish the first two objectives.

All participants utilized Network computer services in their teaching programs with varying degrees of success.

Although National Science Foundation funding has expired most schools are planning to continue Network activities at their own expense. Several have obtained additional local computing equipment as a result of the Network experiment.

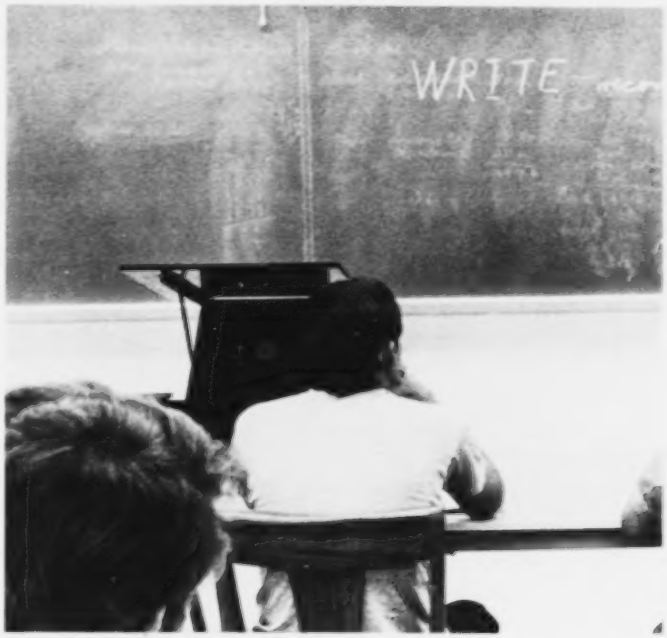
The Network, then, will continue to exist on a self-sustaining basis, and the staff of The University of Texas at Austin Computation Center will remain available to Network participants for aid and assistance.

CREDITS

Judith G. Malkin, Editor

Clint Dare, Design

F. W. Schmidt, Photography (Except for pages 6, 16, 29, Texas Southern University; 7, Harper Leiper Studios; 9, Angelo State University; 10, 12, University of Texas; 15, 18, Abilene Christian College)



Classroom scenes from Texas Lutheran College . . .

. . . Austin High School

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Introduction

The Southwest Region Educational Computer Network (SRECN) was first established July 1, 1969, by eight colleges and universities as an experimental project in cooperation with the National Science Foundation (NSF).

The University of Texas at Austin acted as coordinator in developing the Network and agreed to serve as the lead institution in providing remote computing services and in coordinating curriculum development programs.

The National Science Foundation awarded each institution a two-year grant to encourage its participation, and permitted extension of the grants for a third year.

The original participants and NSF grant numbers were The University of Texas at Austin (GJ-741); Abilene Christian College, Abilene (GJ-742); St. Edward's University, Austin (GJ-743); Southwest Texas State University, San Marcos (GJ-744); Southwestern University, Georgetown (GJ-745); Texas Lutheran College, Seguin (GJ-746); Texas Southern University, Houston (GJ-747); and Trinity University, San Antonio (GJ-748).

Texas Southern University simultaneously requested and received a NSF grant for participation in a two-year educational computer network with Texas A&M University as lead institution.

Huston-Tillotson College, Austin, received a grant through a program established by the Southern Regional Educational Board and supported by the NSF. In that program, Huston-Tillotson obtains its computer services from The University of Texas at Austin; therefore, it is for all intents and purposes an "original" Network member.

Rice University joined the Network during the first year after obtaining the consent of the NSF.

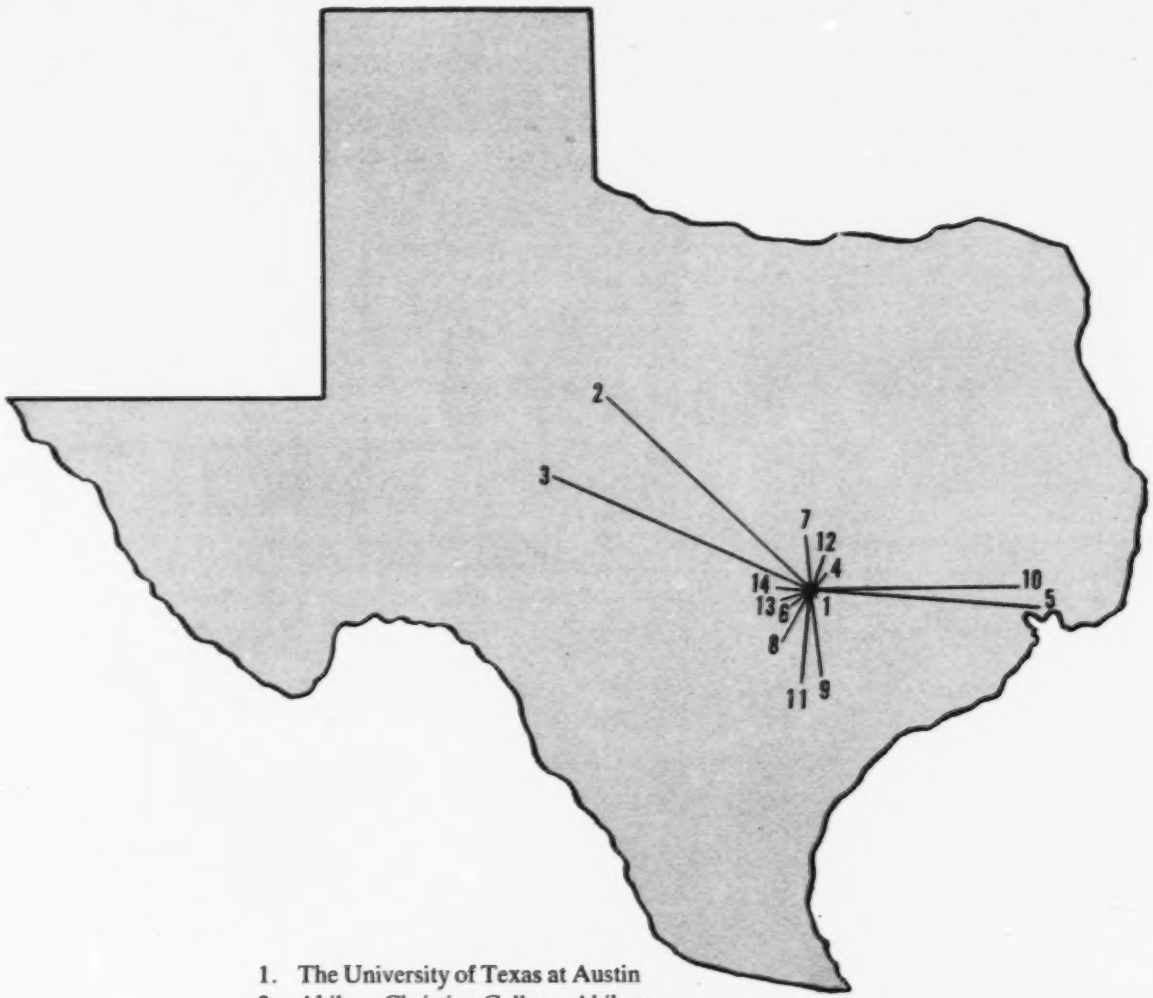
During the second year of operation, St. Stephen's Episcopal School, a private secondary school, and the Austin Independent School District (AISD) requested and received permission to join the Network.

Angelo State University, San Angelo, requested and received a one-year NSF grant (GJ-28845) to participate during the 1971–1972 academic year.

Trinity University, with significant computing facilities of its own, chose not to extend its grant into the third year of Network operation.

. . . St. Stephen's Episcopal School

SOUTHWEST REGION EDUCATIONAL COMPUTER NETWORK



1. The University of Texas at Austin
2. Abilene Christian College, Abilene
3. Angelo State University, San Angelo
4. Huston-Tillotson, Austin
5. Rice University, Houston
6. St. Edward's University, Austin
7. Southwestern University, Georgetown
8. Southwest Texas State, San Marcos
9. Texas Lutheran College, Seguin
10. Texas Southern University, Houston
11. Trinity University, San Antonio
12. St. Stephen's Episcopal School, Austin
13. McCallum H.S., Austin
14. Austin H.S., Austin

Figure 1. Network Map

CHAPTER 1

Scope and Objectives of the Regional Activities

THE PARTICIPATING INSTITUTIONS

The Southwest Region Educational Computer Network in 1971–1972 consisted of eleven four-year colleges and universities and three secondary schools varying from 225 to 39,000 students. All the colleges are coeducational, offering baccalaureate programs in the arts and sciences. Six are church-affiliated, three are state-supported, and one is private. One secondary school is church-affiliated and two are public. (See Table 1.)

The University of Texas at Austin, as the lead institution of the Network, is well-equipped and well-qualified to provide central computer services and curriculum coordination and support. The Computation Center has 14 years' experience in providing for academic computing needs. A Computer Sciences Department was formed at UT-Austin in 1966 with approved programs for Masters and Doctor of Philosophy degrees. The Computation Center staff and the Computer Sciences Department faculty provided the essential resources which permitted The University of Texas at Austin to undertake its role as the lead institution in the Network.

Texas Southern University student

OBJECTIVES OF THE NETWORK EXPERIMENT

Computer science as a discipline and the inclusion of computer methods in other disciplines are relative newcomers to the campus. The introduction of computer science and computer methods into the college curriculum has required the presence of adequate computing facilities.

Of the 14 institutions in the Network, only UT-Austin, Rice and Trinity universities had sizeable computing facilities and well-established computing programs on campus.

For those educational institutions without adequate computing facilities and without sufficient funds to acquire them, remote computing services through a network offered a possible compromise. Thus, the Network came into existence, using the extensive remote computer capabilities at the UT-Austin Computation Center.

The Network experiment had as its primary objective the modification and augmentation of the curricula of the Network schools by adding computer science courses and by introducing computer methods into established programs. The achievement of this objective can be seen in the individual coordinators' reports, beginning on page 8.

The second objective was the implementation of the necessary computer terminals, communication links, central site computer hardware, and software systems and development of a library of computer programs to support the curriculum development activity.

St. Edward's University

Rice University

Table 1. Participating Institutions

Name	*Location*	*Faculty*	*Students*	*Affiliation*
Colleges				
Abilene Christian College	Abilene	181	3,200	Church Affiliated
Angelo State University	San Angelo	150	4,200	State Supported
Huston-Tillotson College	Austin	64	750	Church Affiliated, in SREB Network
Rice University	Houston	390	3,163	Private
St. Edward's University	Austin	92	900	Church Affiliated
Southwestern University	Georgetown	70	850	Church Affiliated
Southwest Texas State University	San Marcos	386	9,800	State Supported
Texas Lutheran College	Seguin	63	1,000	Church Affiliated
Texas Southern University	Houston	226	5,500	State Supported; also in Texas A&M Network
Trinity University	San Antonio	205	2,500	Church Affiliated
University of Texas at Austin	Austin	1,800	39,000	State Supported
Secondary Schools				
St. Stephen's Episcopal School	Austin	30	225	Church Affiliated, grades 8–12
McCallum High School	Austin	70	1,800	Public School, grades 10–12
Austin High School	Austin	62	1,200	Public School, grades 10–12

Network Coordinators meeting (left to right): Dr. Fred Homeyer, Dr. David Gillmore, Bernard Baumbach, James Leissner, Dr. James C. Browne, Dr. Charles H. Warlick, Judith G. Malkin, Annadene Silver, Kathy Silva, Llayron Clarkson, Edwin Shaw.

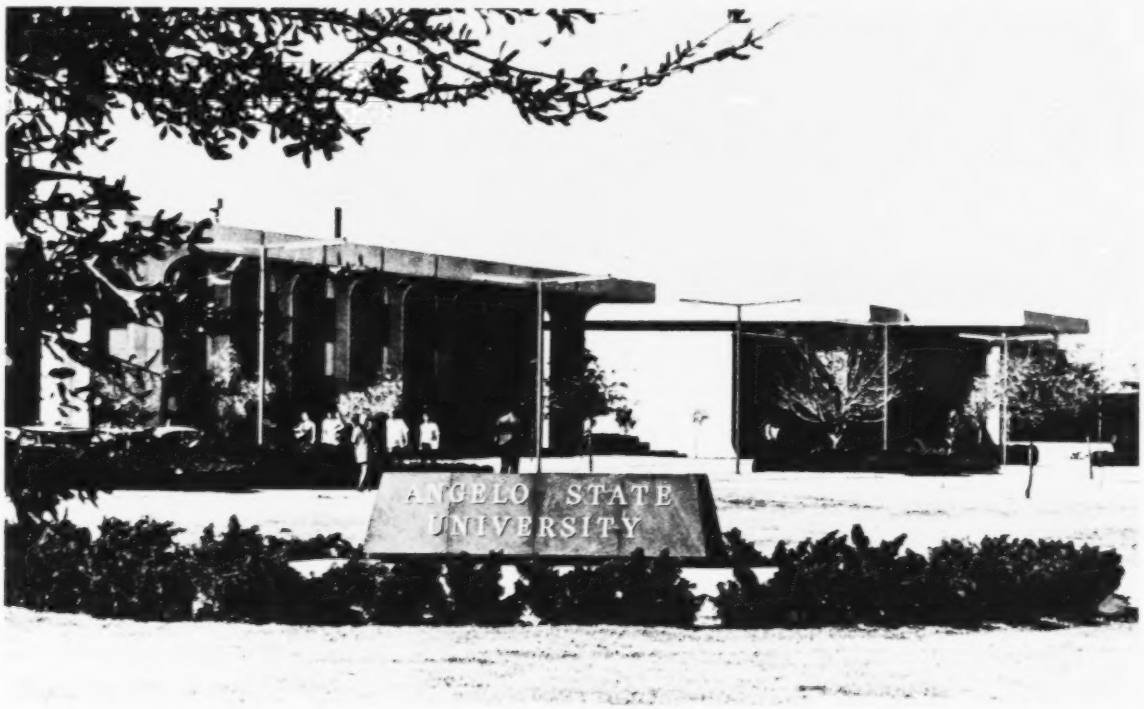
NETWORK ORGANIZATION

Each of the participating institutions chose a coordinator to oversee Network activities and to encourage faculty members to avail themselves of Network resources.

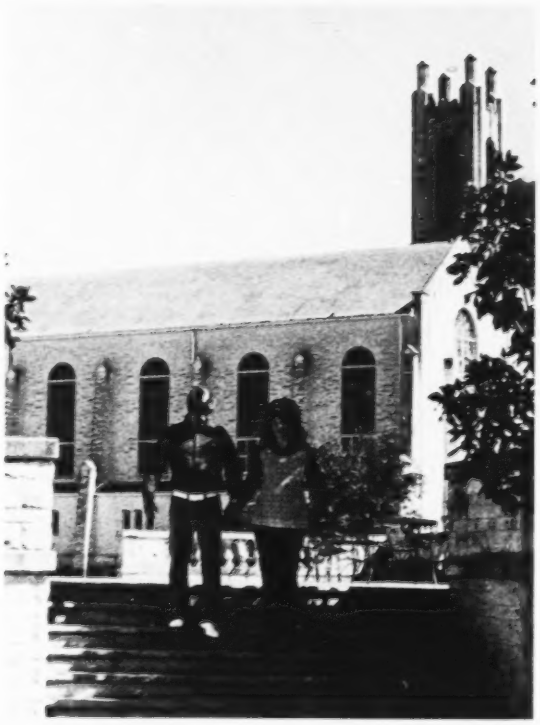
The Network Curriculum Coordinator was a central site staff member whose responsibilities included administration of Network activities, publication of the Network *Newsletter* and "circuit riding" on an as-needed basis.

The coordinators responsible for the administration of Network activities during the final year were Dwight Caughfield, *Abilene Christian College*, Fred C. Homeyer, *Angelo State University*, William F. Paling, *Rice University*, Raymond Spinhirne, *St. Edward's University*, John Prewitt, *Southwest Texas State University*, Bernard C. Baumbach and James C. Leissner, *Texas Lutheran College*, Llayron L. Clarkson, *Texas Southern University*, Annadene H. Silver, *St. Stephen's Episcopal School*, Elgin Schilhab, *Austin Independent School District*, and Judith G. Malkin, *Network Curriculum Coordinator, The University of Texas at Austin.*

Two meetings of the Network coordinators were held during the year, on January 10, 1972, and May 8, 1972. At these meetings, Network experiences were shared, future plans formulated, and operational procedures refined.



Angelo State University



Southwestern University

Southwest Texas State University

CHAPTER 2

Regional Computer System Characteristics

HARDWARE CONFIGURATION

CENTRAL FACILITY

The central computing system for the Network consists of a CDC 6600 computer with 131,072 (60-bit) words of central memory, and a CDC 6400 computer with 65,636 words of central memory, linked via 500,000 words of extended core storage. The 6600 has 10 peripheral processors with 4,192 12-bit memories, and the 6400 has seven peripheral processors. The peripheral processors perform all system functions except the actual logic and arithmetic functions of the two central processors.

Peripheral devices include two card readers (1000 cpm), three line printers (1200 lpm), a card punch (250 cpm), 5 million characters of fast access extended core storage, 620 million characters of disk storage, six 120 KCS tape units, a microfilm recorder, a graphics display console, a 30″ zip mode plotter, and two operator's consoles. Communications multiplexers provide remote access channels at 40,800 bps (8 lines), 2400 bps (16 lines), and 110 and 300 bps (64 lines).

PARTICIPATING SCHOOLS

As in all other characteristics, the computing systems and terminals employed at the participating schools varied widely. Their equipment, by computer systems and by terminals, is summarized in the individual reports from the Network schools. (See pages 18–32)

LANGUAGES AND SERVICES

LANGUAGES

The UT-Austin Computation Center 6600/6400 computer system offers a wide array of programming languages, including FORTRAN, ALGOL, COBOL, SLIP, LISP, SNOBOL, SYMBAL, SCALLOP, L6, MIXAL, and BASIC.

OPERATING SYSTEM

The UT-2D operating system at UT-Austin has been fully developed by the Computation Center systems staff as an outgrowth of the manufacturer-supplied operating systems SCOPE 2.0 and MACE. Compatibility with 6000 series operating and programming systems developed by the manufacturer and by other 6000 series users has been maintained insofar as possible.

Computer room at The University of Texas Computation Center

A preemptive-resume scheduling feature enables the system to automatically schedule jobs according to the resource demand (cost) of the job. This cost is defined as the product of the computer time remaining for the job, times the core required to run it. The lowest cost job in the system is run first. If a job is in execution at a control point when a lower cost job arrives, the higher cost job is interrupted and rolled out to extended core storage and the lower cost job brought into central memory for execution. This feature increased the CP efficiency from approximately 65% to approximately 85%. Because students' jobs tend to be low cost, their programs are given highest priority. However, the higher cost jobs provide background computing demand and the turnaround time of higher cost jobs is minimized.

REMOTE TERMINAL SYSTEM

In March, 1967, the Computation Center initiated timesharing service to the Austin campus with the installation of the RESPOND System. Some 264,000 timesharing jobs and 36,000 user hours later, RESPOND was replaced by its successor, TAURUS.

TAURUS stands for *T*exas *A*nthropocentric *U*biquitious *R*esponsive *U*ser *S*ystem. It is an integral part of the Computation Center 6600/6400 dual operating system, UT-2D, making possible a highly reliable and powerful implementation of timesharing service.

The three components of the timesharing service —terminal communications, file editing, and file storage—were implemented in a modular fashion under the UT-2D operating system. Strictly speaking, TAURUS is only the terminal communication portion of the operating system. TAURUS is structured so that any user who knows how to use the computer in batch mode is able to use TAURUS with almost no further instruction. However, TAURUS allows the sophisticated timesharing user to interface with the computer in an extremely powerful fashion.

TAURUS accepts a large variety of console terminals and supports graphic terminal devices by providing a fully transparent, binary read and write capability. With the installation of UT-2D and TAURUS, the Computation Center moved another step forward in providing complete, state-of-the-art computational services to the educational community.

COMMUNICATIONS

All Network schools except Rice University and Southwest Texas State University communicate with the 6600/6400 operating system exclusively through the teletypewriter interface.

The teletypes are connected to the UT system through a 50-unit rotary switch which is in turn connected to the 6676 multiplexer via two 103E data stations. This switching system takes care of multiplexer port contention. The multiplexer driver (TAURUS) handles both character mode and transparent binary input and output.

Rice University operates a CDC 200 User Terminal at 2000 bps in a remote job entry mode.

Southwest Texas State University operates an IBM 1130, also in remote job entry mode, using a program which simulates a CDC 200 User Terminal.

All Network schools except the Austin schools, Southwestern, and Southwest Texas, use GSA telephone lines which reduce line costs considerably. Because of the relatively low line cost and the small number of terminals at each location, line multiplexing was not economical. Southwest Texas State University, however, acquired equipment in November, 1971, that will multiplex one 2400/4800 bps channel with up to six 110 bps teletypewriter channels via a 15,000 KHz microwave subcarrier. The microwave channel is a part of the Texas Educational Microwave Project master channel running from Austin to San Antonio via San Marcos.

No telpak lines or line conditioning are used in the Network.

Except for the system installed at Southwest Texas, all modems used in the Network are standard Western Electric modems. The teletypewriter terminals had 103A, 101C, or 113A modems. The remote job entry terminals at Rice and Southwest Texas have 201A modems. For local campus service, on the other hand, Western Electric modems were replaced by highly versatile short haul modems manufactured by Computer Transmission Corporation.

The performance of Southwestern Bell Telephone Company was superb. The Network Curriculum Coordinator and the Southwestern Bell data services field representative were able to centralize all specifications, orders, and scheduling of terminals and lines very efficiently. Unusual as it

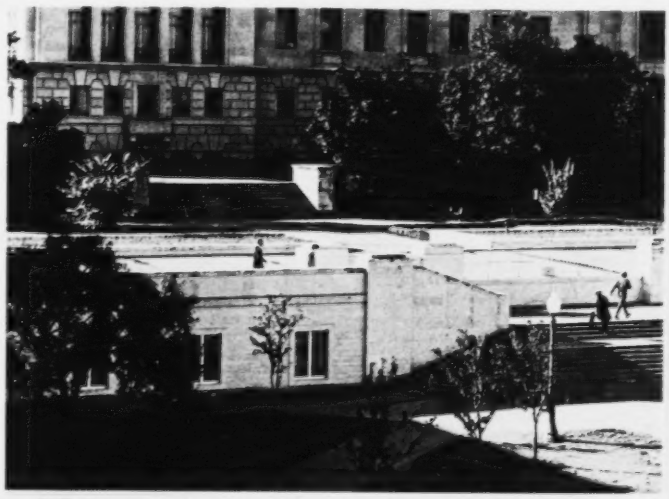
may sound, there were no start-up problems in the communication area.

After April 1, 1971, the telephone company no longer leased new teletypewriter terminals. This affected two new Network schools: Angelo State and Austin High School, both of which leased terminals from Western Union Data Services.

LIBRARY AND UTILITY PROGRAMS

In addition to the standard mathematical functions, the on-line system library contains the following library and utility programs, callable either from a control card or from a user's program (this list is not exhaustive):

ALGOL—An optimized ALGOL compiler
BASIC—Compiler for the BASIC language
CATALOG—Catalogs the contents of a file
CLIC—A set of processors for creating and taking courses on the computer
COBOL—A COBOL compiler
COMPASS—6600 assembly language program
CONTOUR—A contour plotting program
DESCAL—A desk calculator program
EBCDIC—Translates IBM EBCDIC (System/360) card decks to standard 6600 codes
EDITOR—Interactive editing system
EDITSYM—Source language program library editing program
EDSTAT—A sub-library of general purpose statistical routines
FORTRAN—An optimized FORTRAN compiler
FRED—A BASIC-like language for programming; has a desk-calculator mode
L6—An interpreter for the Bell Laboratories Low Level Linked List Language
LIBRARY—Provides access to system sub-libraries
LISP—An interpreter for the symmetric list processing language LISP
MIMIC—A general purpose, engineering-oriented numerical integration package
MIXAL—Knuth's assembly language, used in teaching
PLT—Plotter package for Calcomp 763 plotter and CDC 254 microfilm camera, and TSP 212 remote plotter
RFMS—An elaborate general purpose, user-oriented interactive file management system
RUN—An object code optimizing FORTRAN compiler
SCALLOP—An interpreter for a compiler-writing language
SLAB 36—Symbolic matrix interpretive system
SLIP—A FORTRAN embedded list processing language
SNOBOL—An interpreter for a string-oriented list processing language
SPSS—An elaborate package of statistical processors with data management facilities
SRTMRG—Standard, general purpose sort/merge package
TEXEDIT—A powerful text-editing program
SYMBAL—An interpreter for a symbolic algebraic language
TIDY—Cleans up FORTRAN programs which have been heavily edited
TSORT—An in-core sort program



UT Computation Center housing the CDC 6600/6400 computer system

In addition to the on-line library described above, more specialized programs are accessible from remote terminals and batch jobs. (Abstracts of these programs—and others—are listed in a publication, TPA 18, "Program Library Catalog for the CDC 6600 Computer" available from the UT-Austin Computation Center. The program library tape includes a subset of the CDC 6000 series users group, VIM, program library.)

Programs developed by Network participants were made available to other participants by installation in the program library or via the permanent file system.

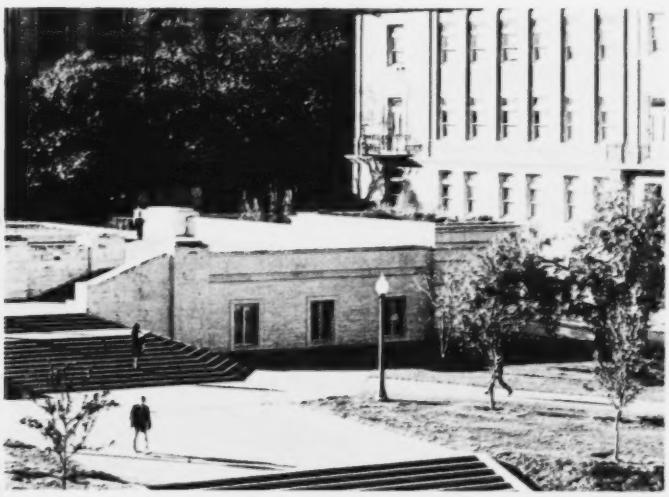
SERVICES

Computing services provided to the Network include a full set of access modes and a wide range of software systems: local batch, high-speed remote batch (40.8 KB), medium speed remote batch (2.4 KB), low speed (110 bps and 300 bps) keyboard terminal access to batch and low speed keyboard interactive access.

In addition to servicing the Network needs, the computer system also provides general computing service for the educational and research activities of UT-Austin.

OPERATING SCHEDULE

The UT-Austin 6600/6400 computer system



operates 24 hours per day, seven days a week with the TAURUS timesharing system operating from 8 a.m. to midnight, Monday through Saturday.

OVERALL NETWORK COMPUTER USE

During the 1971–1972 year, the UT-Austin Computation Center recorded 7,206 hours of computer time in its 6600/6400 computer system. Of this total, the Network institutions used 176 hours, or 2.4% of the total.

Also, the UT-Austin 6600/6400 computers processed 815,425 jobs during the period. The number of Network jobs submitted was 57,313, which amounted to 7.03% of the total processed.

CHARGING ALGORITHMS

The hourly rate of computer time charge at the central site was determined by an annual cost audit performed in accordance with accepted Federal standards. The unit of time charge was defined as the sum of central processor time and data channel reservation time. This was called TM or system time. This unit normalized the measurement of the claims a job placed on the system so that the cost of a job was not affected by system loading. The current rate is $260 per TM hour. (The commercial rate for a 6600 system with comparable turnaround is $1,200 per TM hour.)

In addition to system time charges, TAURUS users are charged $0.50 per hour of connect time. (The comparable commercial rate is $8 per hour.)

MAIL SERVICES

Input mail-in and output mail-out services are provided for users outside Austin who want to run batch programs and do not have a remote job entry terminal. Remote terminal users can divert bulky output to the high speed printers at the central site for automatic mail-out. Large card files can be entered through the central site card readers. Similarly, all of the other output devices at the central site (plotter, microfilm camera, and card punch) can be used from remote terminals with the output returned to the user by mail.

The central site also provides acquisition and warehousing services for remote terminal supplies for the participating institutions. This practice simplifies this aspect of terminal management for the Network coordinators by reducing the requisition procedure to a telephone call. Supplies thus ordered are mailed to the requestor, and charges for the supplies included in the monthly invoice.

NETWORK INSTRUCTIONAL ACTIVITIES

Judy Malkin served as the Network Curriculum Coordinator during the second and third years and was responsible for coordinating both the instructional services provided and the distribution of essential instructional materials. She also served as editor of the Network *Newsletter*.

NEW PARTICIPANTS

Angelo State University received a one-year grant from the National Science Foundation for participation in the Network for 1971–1972. Dr. Fred Homeyer served as Network coordinator and taught several computer sciences classes using teletypewriter terminals.

The Austin Independent School District installed a terminal at Austin High School in September, 1971. Classes taught by Tommie Fenstemaker and Mavis Waggoner utilized the terminal.

In addition to the nine colleges and three secondary schools, two other educational organizations used Network facilities. Region XIII of the State of Texas Educational Service Center and the Southwest Educational Development Laboratory, both in Austin, used the system for statistical analysis of various educational research programs. Coordinators were Dr. David Gillmore for Region XIII and Dr. Hugh Poynor for SEDL.

CONSULTATION FOR NETWORK PARTICIPANTS

The Network Curriculum Coordinator visited each of the Network schools at the beginning of the academic year, and on an as-needed basis for general question-and-answer sessions. Visits were also made to transport the TSP 212 plotter to each school on a rotating basis, following the plotter workshop.

Since each Network school has an Austin telephone line, all members of the Computation Center staff were available for telephone consultation. This feature proved to be most valuable over the three-year period.

The University of Texas student chapter of the Association for Computing Machinery held several short courses on the UT-2D operating system. Faculty members and students from several of the Network schools attended.

FACULTY WORKSHOPS

The Network scheduled workshops several times a year to present topics of special interest to faculty members of the Network schools. The workshops were held on The University of Texas campus, generally for two days. These workshops will continue, although travel funds will no longer be available for participants.

NETWORK USAGE
September–May
1971–1972

	Classes/ Projects (1)	Students/ Users (2)	Jobs
Abilene Christian	15	162	4,252
Angelo State	7	220	1,473
Huston-Tillotson	1	25	744
Rice	5	11	2,295
St. Edward's	4	20	716
Southwest Texas	27	795	16,488
Southwestern	9	138	1,321
Texas Lutheran	9	86	3,772
Texas Southern	10	340	4,381
Austin H.S.	4	200	4,081
McCallum H.S.	3	80	2,499
St. Stephen's School	2	75	3,316

Notes
(1) Classes/Projects reflects the number of separate accounts applied for. In some cases, only one account was used for several separate projects.
(2) Students/Users refers to the number of account numbers issued for each account. Individuals working on two projects may be counted twice using this scheme, and overestimation of class size results in some unused accounts.

PLOTTER WORKSHOP

In October, 1971, the UT-Austin Computation Center purchased a TSP 212 analog plotter (manufactured by Time-Share Peripherals, Danbury, Conn.) for use by the Network schools. (The plotter is designed to be used in conjunction with a remote teletype.)

The plotting package available to Computation Center users was modified slightly to allow specifying the remote plotter as an output device, enabling the user to run the same program to produce central site plots (or films) and remote plots.

Over 30 people attended the plotter workshop, including students from several of the Network institutions. After the workshop, the plotter was sent to the schools on a rotating basis, one month at a time.

As a result, two of the Network institutions—Abilene Christian College and Southwest Texas State University—later purchased their own plotters.

MANAGEMENT INFORMATION SYSTEM WORKSHOP

Fifteen representatives from five Network schools attended a workshop in the Remote File Management System (RFMS), a generalized data management and information retrieval system developed at The University of Texas at Austin.

Such a data management system enables the non-specialist, non-programmer user to obtain information by searching for data satisfying certain requirements, simple or complex.

RFMS has sufficient generality to provide for a wide range of potential users and efficient manipulation of data bases ranging to several hundred million characters. The system may be accessed either by over-the-counter jobs or from remote terminals via the TAURUS timesharing system.

Topics covered during the workshop included general information on data bases, report design, building of data bases and retrieval of information.

OMNITAB WORKSHOP

OMNITAB II, a general purpose interpretive system, was developed by the National Bureau of Standards. It enables the non-programmer to perform statistical and mathematical calculations by means of English-like commands. The OMNITAB-II system is used heavily at the UT-Austin Computation Center.

Seventeen people attended an OMNITAB-II workshop, and several coordinators later demonstrated the system to more faculty members at their own schools.

Students at Abilene Christian College using the TSP-212 plotter

SPECIAL SUMMER COURSE FOR TEACHERS

The first secondary school, St. Stephen's Episcopal School, joined the Network in August, 1970. During the 1970–1971 academic year, two public high schools in Austin made plans to join, and one installed a terminal during the spring of 1970. Because existing courses did not cover precisely the material needed by secondary school teachers, a new course was designed and taught at UT-Austin during the 1971 and 1972 summer sessions.

The course was taught by Lucia McKay, former coordinator for St. Stephen's, and Judy Malkin, Network Curriculum Coordinator. The objective of the course was to make teachers of all subject areas aware of the potential of computers in the classroom, and to provide a background in computer science.

In the summer of 1972, the course was divided into two parts: one course on educational techniques, and one in programming languages and the timesharing system. Teachers were required to take both courses.

A paper describing the course in detail was presented at the Second ACM-SIGCSE Symposium (St. Louis, Missouri, March, 1972). Copies may be obtained from the UT-Austin Computation Center.

ESTIMATED COSTS

The estimated costs of Network participation, exclusive of salaries, are summarized in two accompanying tables.

The following conventions are implicit in the table computations.

1. Intercity communications lines cost includes the cost of the Austin telephone as well as the mileage rate for the line (62c per mile for GSA lines; $3 per mile for Bell lines).

2. "Other terminal costs" include the following items: terminals, special telephone interfaces, modems, and installation charges.

3. Southwest Texas "other terminal costs" includes the entire cost of leasing the IBM 1130 terminal, which is also used in a stand-alone capacity, and the cost of leasing the interface to the microwave equipment.

4. Rice University's terminal costs include maintenance, but not rental, of a CDC 200 User Terminal.

5. "Other supplies" in the 1971–72 cost table refers to such items as printed paper, plotting charges, tape rental, and teletype paper.

Texas Southern University

TABLE OF ESTIMATED COSTS, 1969–1972

School	Central Processor Hours	Central Processor Costs	Connect Time Hours	Connect Time Costs	Communication Lines Miles	Communication Lines Costs	Other Terminal Costs	Total Cost	Total Jobs	Cost Per Job	CP hour/ Connect Hour	Comments
Abilene Christian	86.10	$21,901	3,243	$ 3,513	191	$ 6,300	$ 11,209	$ 42,923	18,151	$2.36	.027	
Angelo State	2.07	538	610	648	181	1,448	2,100	4,734	1,516	3.12	.003	1971–72 only
Huston-Tillotson	4.94	1,270	1,051	961	local	898	5,058	8,187	5,115	1.60	.005	
Rice	76.65	18,107	27	27	147	1,985	12,888	33,008	7,320	4.51	n/a	batch terminal 1970–72
St. Edward's	46.88	9,661	1,117	1,020	local	868	5,059	16,638	5,551	3.00	.042	
Southwest Texas	27.89	7,202	1,178	627	29	2,554	86,345	96,728	24,190	4.00	n/a	microwave and teletypes
Southwestern	10 34	2,448	2,059	1,997	18	2,268	6,547	13,260	12,746	1.04	.005	installed 11/71
Texas Lutheran	17.90	4,528	3,492	2,480	50	2,106	6,387	15,501	12,825	1.21	.005	
Texas Southern	9.41	2,387	2,650	2,248	147	6,952	10,958	22,545	12,393	1.82	.004	
Trinity	6.23	1,368	762	762	70	2,316	4,914	9,360	6,714	1.39	.008	1969–71 only
TOTAL COLLEGE	28,814	$69,411	16,189	$14,283		$27,725	$151,465	$262,884	106,521	$2.47	.018	
Austin HS	2.37	$ 617	371	$ 230	local	$ 135	$ 670	$ 1,652	4,081	$0.40	n/a	1971–72 only; batch and interactive
McCallum H.S.	6.43	1,671	1,419	1,004	local	176	877	3,728	3,257	1.14	.005	3/71–6/72 only
St. Stephens	8.18	2,127	1,789	1,505	local	324	1,704	5,660	8,081	0.70	.005	1970–72 only
TOTAL SECONDARY	16.98	$ 4,415	3,579	$ 2,739		$ 635	$ 3,251	$ 11,040	15,419	$0.72	.005	
TOTAL NETWORK	305.12	$73,826	19,768	$17,022		$28,360	$154,716	$273,924	121,940	$2.25	.015	

Mrs. Ferne Mizell (second from right), McCallum High School

Angelo State University

Austin High School

TABLE OF ESTIMATED COSTS, 1971–72

School	Central Processor Hours	Central Processor Costs	Connect Time Hours	Connect Time Costs	Other Supplies	Intercity Communication Lines Miles	Intercity Communication Lines Costs	Other Terminal Costs	Total Cost	Total Jobs	Cost Per Job	CP hour/ Connect Hour	Comments
Abilene Christian	63.47	$16,503	2534	$1,804	$ 252	191	$ 3,166	$ 4,752	$ 26,477	4574	$5.79	.025	
Angelo State	2.07	538	610	468	4	181	1,448	2,100	4,558	1516	3.00	.003	
Huston-Tillotson	2.24	582	369	279	29	local	324	1,752	2,966	744	3.99	.006	
Rice	18.07	4,699	0	0	169	147	1,256	7,140	13,264	2965	4.47	n/a	
St. Edward's	2.26	589	436	339	81	local	324	1,752	3,085	976	3.16	.005	
Southwest Texas	18.00	4,679	1178	627	598	29	727	47,718	54,349	16723	3.25	n/a	batch and interactive
Southwestern	3.01	782	519	457	122	18	972	2,112	4,445	1456	3.05	.006	
Texas Lutheran	8.29	2,154	2084	1,072	231	50	1,128	2,644	7,229	3781	1.91	.004	
Texas Southern	3.92	1,019	1433	1,031	42	147	3,767	5,694	11,553	4929	2.34	.003	
TOTAL COLLEGE	121.33	$31,545	9163	$6,077	$1,528		$13,112	$75,664	$127,926	37664	$3.40	.013	
Austin H.S.	2.37	$ 617	371	$ 230	$ 197	local	$ 135	$ 670	$ 1,849	4081	$0.45	n/a	batch and interactive
McCallum H.S.	4.13	1,073	990	575	199	local	135	658	2,640	2499	1.06	.004	
St. Stephen's	4.06	1,056	1040	756	163	local	162	1,828	2,965	3358	0.88	.004	
TOTAL SECONDARY	10.56	$ 2,746	2401	$1,561	$ 599		$ 432	$ 2,156	$ 7,454	9938	$0.75	.004	
TOTAL NETWORK	131.89	$34,291	11564	$7,638	$2,087		$13,544	$77,820	$135,380	47602	$2.84	.011	

CHAPTER 3

Final Report From Network Participants

ABILENE CHRISTIAN COLLEGE

Abilene Christian College is a private, four-year, co-educational liberal arts college affiliated with the Church of Christ with a full-time equivalent enrollment of approximately 3,200.

EVALUATION

From comments by Dwight Caughfield, Network coordinator

Abilene Christian Colege has profited greatly from its Network involvement the last three years.

Courses such as numerical analysis and advanced topics in physis were added. Students were able to obtain hands-on experience and rapid turnaround. Better students studied and learned on their own and, since time was paid for by NSF grant funds, they could work on extra-curricular self-learning projects. This coordinator believes the self-learning process has been one of the prime reasons that a number of students have gone on to work on advanced degrees in computer science at other schools. Since the grant is ending, the amount of computer time used will now have to be cut down.

Three highly qualified men were added to the ACC faculty. They said they would not have come here if computing facilities for continuing their research had not been available.

Because of our Network facilities, new grants are being awarded to our faculty for both classroom and research activities. At least five of these grants depended on the school having access to large computing facilities.

The administration became aware of the importance of an adequate computing capability for academic and research purposes.

At least for the next two years, ACC will actively remain in the Network with the school providing funds to enable us to participate at the 1970–71 level which was approximately $16,000 if the school had paid all cost. This is below the 1971–72 spending level but it is hoped that some of the smaller jobs can be run on the IBM 360/40 that will be coming to replace the IBM 1401 used for administrative purposes. For the time being, we will continue to use Model 33 ASR teletypes with perhaps three or four multiplexed on one line, but we would like to obtain a remote batch terminal when possible since we have greatly increased our input/output requirements over the last three years.

Abilene Christian College

HARDWARE CONFIGURATION

Stand-alone computers: one IBM 1401 with 12K core. Its use is primarly administrative, although small FORTRAN programs are run with a one day turnaround

Used for Network activities: three Model 33 ASR teletypes with the capability of using only two on line at a time; a TSP 212 Remote Plotter.

SERVICES

- Write-ups of programs written at ACC.
- Student assistants available from 10 a.m. to noon, 1 p.m. to 9 p.m. to aid users in running and debugging their programs.
- Seminars by the coordinator as needed. During the year, seminars dealt with the TAURUS system (four lectures); BASIC programming (three lectures), advanced features of the system (three lectures) and the use of OMNITAB (five lectures).
- Several special application programs were written by the coordinator and student asistants as requested by faculty members or as needed to enhance remote time sharing procedures.

COURSES USING NETWORK SERVICES

Computer Science: programming, advanced programming seminar.

Mathematical and Physical Science: numerical analysis I & II; engineering physics lab; modern physics lab; physical chemistry lab; advanced topics in physics.

Business: business cycles.

Arts and Humanities: three graduate students made use of the EDSTAT packages to analyze their research data in writing their theses.

The primary use in the engineering physics, modern physics and physical chemistry lab was use of curve fitting programs to smooth data. These programs and instructions in how to use them and the teletype were provided by the local Network staff.

In advanced topics in physics, junior and senior students did individual research which involved writing their own FORTRAN programs and/or using UT library programs.

In the business cycles class for seniors, curve fitting programs were used to fit data and then project (forecast) to a future point on the trend curve.

ANGELO STATE UNIVERSITY

Angelo State University, San Angelo, a state-supported co-educational institution, is one of the most recently established four-year institutions of higher education in Texas, having gained status as a four-year college in 1963. The ASU fall 1971 enrollment was 3,892. The graduate program was initiated in September, 1971, with 99 students.

EVALUATION

From comments by Dr. Fred C. Homeyer, Network coordinator

Angelo State University joined the Network in June, 1971. The primary objective has been to foster a developing interest in the use of the Network computing facilities among ASU students and faculty.

In September, 1971, a demonstration of the Network facilities was presented to interested faculty members, with over 75 persons attending. Four workshops were held during the following weeks on using TAURUS, EDSTAT, BASIC and RFMS. Over 1,000 students witnessed demonstrations and over 400 students personally wrote and executed programs using Network facilities. The primary programming language used by the students was BASIC. The most popular demonstration programs were FOXRAB, BLKJCK, ROCKET, FORTS, OSCIL and RACE (a race car simulation written by a student at Angelo State). Several faculty members are using the Network computer to develop curriculum material in biology, German, and computer science.

By using the facilities provided through continued Network participation, ASU will offer an undergraduate major in computer science with either commercial or scientific emphasis beginning in the fall of 1972. It is anticipated that Network participation as well as the computer science major program will have a strong and lasting impact upon education in West Texas.

HARDWARE CONFIGURATION

IBM 360 Model 25; 24K core storage; 2540 card-read-punch; 1443 line printer; two 2311 disc drives; five 029 keypunches; 087 sorter; two Model 33 ASR teletypes.

COURSES USING NETWORK SERVICES

Business Administration 1331: principles of data processing.

Accounting 2301: principles of accounting

Physics 2421: intermediate physics

Computer Science 2181: programming lab

Computer Science 2401: introduction to computer sciences

Computer Science 2311: computer organization and programming

AUSTIN INDEPENDENT SCHOOL DISTRICT

McCallum High School has an enrollment of approximately 1,900 students in grades 10, 11, and 12.

Austin High School has approximately 1,200 students in grades 10, 11, and 12. They are two of seven public high schools in the Austin Independent School District.

EVALUATION

From comments by Elgin Schilhab, Network coordinator

McCallum's second year of participation in the

Mrs. Tommie Fenstemaker (c), Austin High School

SRECN intensified student interest in computers and computer terminals and their adaptability to problem solving. Through student interest and activity, the administration and teaching staff have become convinced of the value and importance of the computer in general and of the Network in particular.

Austin High joined the Network in September, 1971, and the facilities of the Network were most useful in the activities related to permanent files and the Remote File Management System.

HARDWARE CONFIGURATION

McCallum: one Model 33 ASR teletypewriter to support two sections of a computer mathematics course.

Austin: one Model 33 ASR teletypewriter used as a conversational terminal to support two data processing classes and one computer mathematics class. The majority of the problems which were run to support these classes were batch. The terminals were used for jobs which required immediate responses.

COURSES USING NETWORK SERVICES

McCallum: computer mathematics course, consisting of a six week introduction to programming, followed by 12 weeks of problem-solving activities. Students were introduced to both BASIC and FORTRAN and utilized either language to solve their problems. In addition, students from biology, physics and other mathematics classes utilized simulations to enhance their knowledge of these courses.

Austin: two data processing classes and one computer mathematics class. In the data processing classes, students were encouraged to become familiar with COBOL, BASIC, FORTRAN, and RPG. To support their program, the school purchases computer time from local businesses as well as from UT-Austin.

An effort was made to develop a local CAI instructional package to support students in a learning laboratory. Although several remedial programs in mathematics were developed, the activity was minimized by logistics problems.

HUSTON-TILLOTSON COLLEGE

Huston-Tillotson College, Austin, is a four-year liberal arts, private college. Its average enrollment of 842 students comes from 24 states and from 12 foreign countries. It has a cooperative relationship with neighboring St. Edward's University, Concordia College and The University of Texas at Austin.

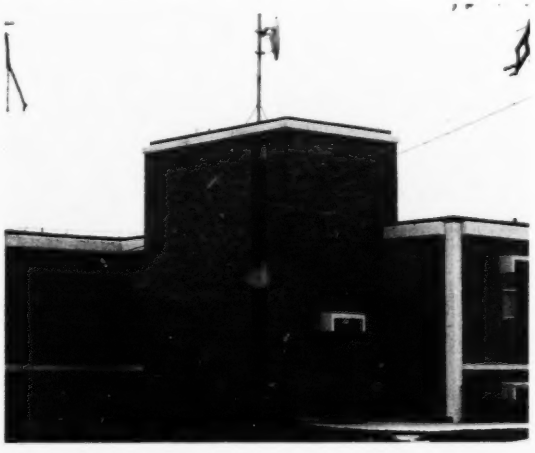
EVALUATION

From comments by Dean E. A. Delco, Network coordinator

In attempting to evaluate a program at Huston-Tillotson, we are most concerned about the amount of career potential, immediate and long-range interest our students develop from the exposure to the program, and the general good the program has to offer the College totally. We are proud to indicate that eight graduates are now utilizing their skills in computer science and the college is currently installing an IBM 1130. Programs have been prepared for the business function of the College and within a month other administrative officers will undergo training in the use of the apparatus. Additionally, the campus facility will be operative for classroom activity in the fall of 1972.

HARDWARE CONFIGURATION

Two Model 33 ASR teletype terminals; currently installing two additional terminals and an IBM 1130 computer.



Huston-Tillotson College

SERVICES

The room containing the two teletype terminals remains open from 10 a.m. until 10 p.m., six days a week. The terminals are used approximately six hours per day or about 50% of the time.

COURSES USING NETWORK SERVICES

Computer Programming I: introduction, organization and capabilities, formulating algorithms, basic FORTRAN programming.

Computer Programming II: advanced FORTRAN programming, ELASTIC.

Biology: genetics, in which the facilities were used to help determine population spread in several heterozygote crosses.

Chemistry: advanced organic chemistry, in which the facilities were used to help determine organic compounds from unknowns.

ST. EDWARD'S UNIVERSITY

St. Edward's University, Austin, is a private four-year liberal arts college with an enrollment of approximately 1,200. This includes approximately 100 MBA students and 100 part-time evening business students. The remaining students are divided between departments as follows: humanities (18%), fine arts (4%), social science (15%), physical and biological sciences (17%), behavioral sciences (14%) and business administration (32%).

EVALUATION

From comments by Raymond Spinhirne, Network coordinator

The remote terminal system has had limited use at St. Edward's. I feel there are three primary reasons for this.

Dr. Paul White, Physics Department, St. Edward's University (left), and one of his students using the Network facilities in a physics laboratory.

1. We have our own computer(s) and most courses are offered on an introductory level. Therefore, our own computers were used because of their much simpler control card system and because they were familiar to the instructors of these introductory courses.

2. In the beginning years of the Network, problems and down-time at the central site were significantly greater than for our own computers. This fact discouraged those few individuals who were interested in the activity and most of them did not exert the effort necessary to make the transition from RESPOND to TAURUS.

3. A large percentage of the faculty and student body are involved in non-scientific disciplines. These people, for the most part, fail to understand the basic concepts of computer usage and the critical faculty support is not present.

In summary, one could say that the remote usage has played a very important role in the development of a few specially interested students. However, its impact on the total academic and instruction process has not been significant.

HARDWARE CONFIGURATION

IBM 1620, 20K core, 1622 read punch (card system); IBM 1130, 8K core, 1442 read punch, 1132 printer; two Model 33 ASR telephone terminals. (Languages: 1130 system—RPG, FORTRAN, ASSEMBLER)

SERVICES

Batch runs on 1130 six times per day; terminals available 9 a.m.–5 p.m., Monday through Friday.

COURSES USING NETWORK SERVICES

Physics: introductory physical laws used a limited amount of simulation programs.

In-house programs available on IBM 1130; disk sort subroutine, fast sort of disk files written in ASSEMBLER; RANDOM subroutine (FORTRAN); statistical analysis programs (FORTRAN); business simulation game (FORTRAN).

ST. STEPHEN'S EPISCOPAL SCHOOL

St. Stephen's Episcopal School, Austin, is a private secondary school with about 200 students.

EVALUATION

From comments by Annadene Silver, Network co-ordinator

The successes we encountered were to prove that computing can be learned easily at the high school level and that with cooperation from teachers, courses can be significantly aided with the help of the computer. Students are more enthusiastic with the one to one encounter between themselves and the computer and in the sciences whole new horizons can be reached because of speed and capabilities of the computer. The impact on this campus was tremendous with the students, but very small with the faculty because of a fear of being "replaced" by the machine. Faculty workshops at the beginning of the academic year elicited much interest, which unfortunately rapidly declined as time went on.

The co-ordinator during this year was a graduate student in computer sciences at UT-Austin, and was only able to be on the St. Stephen's campus two half-days a week. This accounted in a large part for the failure of the full-time faculty to do any significant work with the computer, since they needed to be in constant contact with the coordinator, in order to build up their own confidence and expertise in using the machine. The coordinator for next year is a resident faculty member, and we hope to see an increase in faculty involvement.

HARDWARE CONFIGURATION

One Model 33 ASR teletype connected to the UT-Austin CDC 6400/6600, which was available to students from 8 a.m. until 11 p.m.

SERVICES

The terminal was used approximately 85% of the time available.

COURSES USING NETWORK SERVICES

Mathematics, history, German and computer science courses have used the computing facilities. The coordinator taught intermediate and advanced computer science courses, including a wide selection of the languages available on the 6400/6600 system.

SOUTHWEST TEXAS STATE UNIVERSITY

Southwest Texas State University, San Marcos, is a senior co-educational state-supported, liberal arts, teacher education and vocational institution. The total student enrollment is about 11,000. The faculty numbers about 440 and the average class size is 25.

EVALUATION

From comments by John Prewitt, Network coordinator

In addition to a computer science minor in the mathematics department, the business administration department has incorporated a degree program whereby a student may major in business with an emphasis in computer science. SWTSU is now in the process of developing a major in the computer science field.

Due to the fact that statistical programs such as OMNITAB, SPSS, and EDSTAT are available at UT-Austin via the remote job entry terminal, upper division courses in biology, sociology, psychology, etc., have started using the above programs in their courses. We anticipate more use in this area.

Three years is not enough time for an educational institution to establish an adequate computer program. The support given by NSF to establish these programs could be wasted if the educational institution dropped its computer program because it could not stabilize its cost. In other words, the sudden withdrawal of funds could be devastating. I suggest that in the future NSF should fund these projects longer and gradually withdraw its support.

HARDWARE CONFIGURATION

SWTSU's computer requirements are provided for by two centers. The Data Processing Center rents an IBM 360/20 with four tape drives, a multi-function card unit, a 600 line-a-minute printer, and miscellaneous unit record and key punch machines for the purpose of student records, general accounting, library records, inventory, and payroll. The Computer Center rents an IBM 1130, 16K computer system, used to aid research and educational programs. The IBM 1130 can be used as a stand alone facility, but is primarily used as remote job entry terminal to the CDC 6600/6400 computer system at UT-Austin.

During the past year, Southwest Texas purchased five Model 33 ASR teletypes and one Datapoint 3300 terminal to be used as interactive terminals to UT-Austin's system. In addition, the communication link with UT-Austin was switched from a telephone network to a microwave network by renting a Communication Transmission Corporation data line multiplexer.

In the future, the Computer Center plans to replace the IBM 1130 with a Digital Equipment Corporation PDP 11/20 disk operating system with two tape transports, a 2.4 million-word disk cartridge system, a high speed paper tape reader/punch, 16K of core memory, 300 card per minute card reader, and a 245–1100 line per minute, variable speed printer. This computer system has four times the throughput with only a 5% increase in cost.

UTILIZATION

In the past year, the use of the IBM 1130 as a remote job entry terminal has increased from 10% to 65%. This was due to the following:

1. The IBM 1130 FORTRAN is a basic version and lacks standard features of the FORTRAN IV such as logical IF statements. Therefore, the FORTRAN IV compiler at UT-Austin was used.

2. The MIX assembler was used instead of the IBM 1130 assembler language for the assembly language course.

3. After the incorporation of OMNITAB II on the CDC 6600/6400 computer system, over 100 additional students and faculty began to use it.

Southwest Texas State University

COURSES USING NETWORK SERVICES

Computer Organization and Programming I: logical basis of a digital computer system; machine representation of numbers and characters; flow of control; arithmetic and logical operations; machine control; input-output; basic number codes; programming in FORTRAN.

Computer Organization and Programming II: digital computer organization; Boolean algebra and logic operations; systematic minimization techniques; number systems; basic algorithmic processes, MIX.

COBOL Programming: concepts of data processing; basic computer philosophy; fundamentals and techniques of COBOL programming; introduction to computer system analysis design.

Computer Organization and Programming III: organization of a large scale digital computer; instructions and format; basic assembler language coding; formulation and solution of a variety of numerical and non-numerical problems in one or more problem-oriented languages. FORTRAN, TAURUS, plotting package.

Non-Mathematical Statistics: non-mathematical introduction to random sampling; mean, variance; statistical inference; testing hypotheses and regression analysis.

Computer Applications to Statistical Methods: variance analysis; correlations; linear regression and curve fitting. FORTRAN, STIL (interactive statistics package).

Introduction to Numerical Analysis: basic numerical methods for function evaluation; root finding; interpolation; numerical differentiation; and numerical integration.

Computer Applications to Numerical Analysis: topics such as linear programming; evaluation of integrals; approximate solutions of equations; solutions of differential equations. FORTRAN, plotting package

Chemistry: thesis. FORTRAN.

Biometry: basic principles of statistical methods as applied to biological problems such as sampling techniques, analysis of data, experimental design and population dynamics. FORTRAN, OMNITAB, TAURUS.

Statistics for the Behavioral Sciences: application of elementary descriptive statistics, statistical inference, and correlation and regression to sociological and other behavioral science data with an emphasis on the relationship of theory and method in the research setting. FORTRAN, SPSS.

Introduction to Social Research: logic and basic techniques in sociological research, required of all sociology majors. FORTRAN, SPSS.

Data Processing: fundamentals; functions of punched card machines; introduction to the computer. BASIC, TAURUS.

Business Statistics: collection, organization, and

analysis of data relative to units of measurement; classification and presentation; averages, index numbers, and similar data; emphasis upon the application of statistics to business problems. STIL (Statistical Interactive Language), TAURUS.

Marketing Research: nature and scope of marketing research, marketing research procedures and techniques; planning the research; data collection; sampling analysis; other basic factors in marketing research. FORTRAN.

Seminar for Computer Science in Business: the design construction, and programming of computer solutions in the fields of business and economics. FORTRAN, COBOL.

Faculty Research: FORTRAN, OMNITAB, SPSS, TAURUS, plotting package.

Dr. Ralph Whitmore (standing) and Prof. Michael Mezzino, Southwestern University

SOUTHWESTERN UNIVERSITY

Southwestern University, Georgetown, is a private four-year institution offering baccalaureate degrees in the arts, fine arts and sciences. The current enrollment is approximately 850. Southwestern's general academic aims are to offer a rigorous and relevant undergraduate education based on close personal relationships and tailored to each student's needs and abilities. Over half of Southwestern's graduates complete graduate school programs.

EVALUATION

From comments by Dr. Ralph Whitmore, Network coordinator

Network computing activities at Southwestern began with primary use limited to a small class in programming. By the end of the first year, interest in the network and the use of the terminals had spread to classes in physics, chemistry and mathematics.

During the second year, widespread interest developed in the use of computation equipment in the area of social sciences with some limited work in classes in economics, business administration and psychology. A significant increase in computer-assisted work in the natural sciences also occurred.

The increased awareness of computing equipment generated during the second year led to a decision by the university to install an IBM 1130 during the third year in order to support the business and economics departments. As a result of this installation the mathematics department has revised course requirements for the social science student. The previous three semester sequence of pre-calculus, introductory calculus, and general statistics has been replaced by a semester of function and calculus concepts, a semester of computer programming with applications to descriptive statistics, and a semester of inferential statistics with computer use required.

Basic courses in computer sciences and numerical analysis have been implemented and considerable independent study projects are being undertaken by students using the computer.

In summary, the Network has had a major role in updating and improving the total academic program at Southwestern. Currently efforts are being made to place some of the functions of the registrar's office on the computer.

HARDWARE CONFIGURATION

IBM 1130 Mod. 2 Version 13; two Model 33 ASR teletype terminals.

Languages available: COBOL, RPG, FORTRAN, ASSEMBLER.

COURSES USING NETWORK SERVICES

Introductory Computer Science.

Applied Statistics: averages, standard deviations, correlation coefficients.

Numerical Analysis: polynominals.

Differential Equations: numerical solution of differential equations, classical methods, such as Runge-Kutta, etc.

Selected Topics in Physical Chemistry: numerical integration, curve fitting, particle simulation.

Macroeconomics: averages, standard deviations, straight line fitting.

Classical Mechanics: general curve fitting.

Education, Tests and Measurements: correlation, inference tests.

TEXAS LUTHERAN COLLEGE

Texas Lutheran College, Seguin, is a fully accredited, private, co-educational, liberal arts college affiliated with the American Lutheran Church. It offers the B.A. and B.S. degrees in 25 areas and the B.M.Ed. degree. In 1971–1972, it had an enrollment of just over 1,000 students. Its faculty numbers 68 full-time and part-time members.

EVALUATION

From comments by James Leissner, Network coordinator

The impact of Network participation on TLC is difficult to measure. Some indications of it are obvious. We have added computing courses to our curriculum. Personnel with computing experience have been hired. In addition, it is hoped that we will continue our association with the Network and increase our terminal capabilities.

The most important and desired result seems not to have occurred as yet. That result will be a change of philosophy in those people who have been unable to recognize the usefulness of computing in education. It is hoped that this change can come about and it is known that this grant has done a great deal toward making that change possible.

HARDWARE CONFIGURATION

Two Model 33 ASR teletypewriters serviced by GSA telephone lines, provide direct access to UT-Austin and the Computation Center. During the January interim, when an intensive programming course is taught, two additional teletypewriters are installed to operate off-line in order that preparation of the student's programs and data bases on punched tape will not needlessly exploit the on-line machines.

Prof. James C. Leissner (right, above), Texas Lutheran College

UTILIZATION

Throughout the months of September, 1971, through April, 1972, total connect time with TAURUS amounted to an average of approximately 9.3 hours per day (based on a 22 working-day month). This was about 75% of the available time.

COURSES USING NETWORK SERVICES

Introductory Concepts and Programming
Computer Programming for Science Students
Introductory Computer Programming
Computer Programming for the Physical Sciences
Math 420: COBOL programming
Quantitative Analysis
Physical Chemistry
Spectroscopy
Special Problems

Inasmuch as the chemistry department is the exclusive utilizer of TAURUS in conjunction with the regular chemistry courses, the use to which the system has been put during this past year pertained primarily to experiment stimulation, data processing, and problem solving as aspects of the laboratory and research experiences.

TEXAS SOUTHERN UNIVERSITY

Texas Southern University, Houston, is a fully state-supported institution of higher education, established in 1947. TSU has an average enrollment of approximately 5,500 students.

EVALUATION

From comments by Dr. Llayron L. Clarkson, Network coordinator

The purpose of this report is to briefly describe the progress TSU has made in the educational utilization of computers in the past three years with emphasis on the growth which we consider as a direct consequence of the Southwest Region Educational Computer Network (SRECN). Before TSU entered the Network, many of its concerned staff members had read and discussed such documents as *Computers in Education*, The White House, Washington, D.C., February, 1967, and a *Study of the Role and Scope of Computers in the Texas System of Higher Education* which was submitted to the Coordinating Board, Texas College and University Systems in December, 1967. In particular, the local Data Processing Committee had considered the local data computer education situation in relation to the information contained in a series of documents and reports and had subsequently identified several computer education goals that were both reasonable and attainable, providing sufficient personnel and other resources were made available.

Prior to its participation in SRECN, it was clear that Texas Southern University did not have the leadership personnel required for a rich computer education development program and that the State of Texas was not inclined to adopt a policy for financing computers for higher educational usages. (In fact, at the time of this report in mid-1972, the State of Texas still had not adopted such a policy). It was also clear that the TSU computer education goals were at most tentative and maybe even impractical since they were developed by computer lay personnel and without any firm knowledge of future dependable funding sources. When TSU was invited to participate in SRECN, it was determined that a significant number of the outlined goals could be temporarily met through this project. Almost simultaneously, TSU was invited to participate in the Texas Regional Academic Computing Experiment which was centered at Texas A&M University at College Station, Texas.

TSU entered the two network projects in mid-1968, but the associated equipment for each project was not completely installed and operational until the later part of 1968. By the start of 1969, TSU had moved from a position of practically no hardware capabilities to access to the Texas A&M IBM 360/65 through a NCR 735 tape to tape transmission device and access to The University of Texas at Austin CDC 6600 through the use of Model 33 ASR teletype terminals and finally some additional on-campus capabilities by having the capacity of the IBM 1401 capacity increased by converting it from an 8K to a 16K machine with 4-tape and two disk drives.

Professor Tarsem Singh (left) explains the use of computer programs to his students at TSU

Successes Directly Attributable to SRECN. In terms of our declared aims upon entering the SRECN, the Network can claim a considerable amount of success. Practically every instructional component of TSU is now fully aware of the changes taking place in higher education due to computers. Through the workshops and the dissemination of materials and reference to the literature there has been a significant awakening to the general impact of computers on the society, but more specifically on how computers are presently being used to make the teaching-learning situation richer and more practical. A strong push has been given by the recent trends for more accountability for results on the parts of teachers and students.

There have been changes in teaching practices from the so-called conventional techniques to that of an activity-oriented learning situation. This is not to say that all teachers are willing to change their practices; this is much more than we could expect where traditional methods are deeply ingrained in a vast number of teachers. There is evidence, however, that the Network activities have succeeded in bringing about some changes and innovations in our instructional program. As successes are announced, we find more and more teachers inquisitive as to how they can adjust their course outlines to take advantage of computer technology.

To illustrate the type of successes we have experienced, the Chemistry Department has reported that students gain information from having experimental data analyzed by the computer and are better able to appreciate precision and accuracy of data obtained in an experiment. Before we were involved in the Network only raw data were submitted that students more often than not did not evaluate. Data base processing was used for such

things as molar volume, volumetric analysis, gravimetric analysis, equilibrium and rate.

In the Mathematics Department a unit was developed for our freshman liberal arts students with emphasis on relevance of computers to our daily lives. With the availability of on-line terminals a significant number of students were able to run prepared programs on such things as compound interest, solving simple equations and finding statistical measurements. In a few cases the students did some program writing themselves. As a result of these experiences, many students decided to take freshman level computer programming courses and many will probably continue their computer education beyond that level. Of course the terminals were used in our numerical analysis courses. To this date, the use of computers in our calculus classes is only in the discussion stages. In our various teacher training classes we have moved to include a significant amount of computer education topics including hands-on experience. This is as it should be since many of the Houston area schools already have computer terminals installed and are offering computer related courses with mathematics teachers in charge. Because of the Mathematics Department's activities, the President of the University has recently charged the department with developing a basic plan for an undergraduate computer science program.

The terminals were not used as extensively as hoped by the School of Business primarily because of where the terminals were located. The business faculty did make some use of the installation for management games and long linear programming problems, among other things.

Other extensive uses were in the Sociology and Economics Department and in physics. Again, the usage would have been much greater if the terminals had been more suitably placed around the campus.

The really significant successes lie in the fact that all over the campus faculty and staff members are beginning to realize that computers are important to the instructional program and that the experiences gained by students could play significant roles in the opportunities available to them upon graduation. We have also had some success in breaking down the general impression that to use the computers one has to have a great deal of mathematical training. The future seems to be extremely bright providing we can continue to provide the hardware, software and technical assistance required to keep pace with the apparent expanding interests and usage on the campus.

Another important success in our efforts lies in the computer education program provided for local Upward Bound project participants. Among other things we consider this project as part of our talent search among educationally disadvantaged youth. The terminals have been valuable in the implementation of our Upward Bound project. The terminals were also used with our Special Freshman Studies Program and in the training of future teachers who will serve in Africa.

Finally, it is important to note that the terminals were used for some faculty and graduate student research activities.

Partial Successes. At the outset of the network, it was expected that during the course of the project there would be developed for TSU a general five-year comprehensive computer education plan. Such a plan was to include what each instructional unit envisioned for computer usages and, if possible, what hardware and associated software specifications would be required to meet our needs. This aim was not completely achieved.

It was also hoped, but not expressed, that through the intimate relationships with the major institutions, TSU would be assisted in securing funds to either further develop its in-house hardware and software capabilities or to continue in the network-related activities. This aim was not completely achieved.

Finally, TSU was warned that at some point in the development of a computer education program, the interest and required support needed would tend to grow exponentially. It was hoped that before the University became too involved, there would be reliable techniques for determining costs information such as how much computer time would be required to teach certain ideas in, say, a course in sociology. How many programs? What is the average length of a program? Could the concepts or ideas be presented just as well without a computer? There are many similar questions related to instructional areas all over the University. Without this information we have no way to present budget recommendations to the administration nor do we have the capabilities for prorating current costs items. We also need this kind of information in determining how to buy materials and

supplies and in making certain in-house arrangements. It was hoped that we could get some assistance from UT and Texas A&M in assembling and interpreting the appropriate costs data. This aim was not completely achieved.

COURSES USING NETWORK SERVICES

Programming: math 139, 239—FORTRAN; math 477—special topics; business 232—COBOL or FORTRAN.

Mathematical and Physical Sciences: math 141, 142—experimental freshman mathematics courses with emphasis on quantitative and analytical thinking, some use of flow charts as a technique of dividing a large problem into small manageable parts. The applications were in small computational programs; math 137, 138—mandatory sequence for all non-science students with an objective of presenting quick introduction to the computer with a relevant application; math 337—numerical analysis, with many applications; chemistry 141—data analysis of laboratory results.

Biology: biology 141—application was in a statistical study of a controlled and non-controlled freshman biology class.

Social Sciences and Education: psychology 436—application was in use of statistical packages; sociology 131, 234, 432—applications were in use of statistical packages mostly in the study of population data; education 436, 632—application in use of statistical packafes for processing large collections of data.

GENERAL RECOMMENDATIONS

Recommendation 1. Local network coordinators or directors of academic computer activities should not have their primary assignment with any particular instructional areas or office and they should be released from other duties to do whatever is necessary to promote the associated activities. Also, they should have the support of the local administration and this support should be officially announced to the total university family.

It is felt that the resources that were available through each of the SRECN and TRACE networks were not fully utilized by TSU primarily because the time the local coordinator had to spend on the projects was much too limited. At the outset of the project it was rightfully decided that TSU had to make its own decisions about its destiny in the area of computer education and that the networks' experts would assist in the implementations of the computer education activities and they would advise TSU when an aim was not readily attainable with the given constraints. The coordinator should have been free to spend as much time as necessary on each campus, UT-Austin and Texas A&M, to study their computer capabilities and to relate these capabilities to the aspirations and expectations of the TSU family and to cause the necessary action to take place. Unfortunately, this was not done to the fullest extent.

Recommendation 2. It is recommended that for future NSF or other funding agencies computer network projects the majority of the funds should be supplied to the smaller institutions. These funds would be earmarked for the central institutionals with the understanding that they will be distributed according to the fulfillment of certain inter-institutional contractual arrangements.

Recent trends in education, higher and otherwise, is for participants to be more accountable for their expected efforts. The present funding trends deposit most of the funds in the participating developed institution and virtually inadequate funds which require some matching funds in the participating developing institutions. This funding pattern allows the developed institution to further develop and adds financial burdens to the smaller institution's needs. The funding patterns should be changed since among other things, the present arrangements do not leave the major institutions accountable for their contributions.

Recommendation 3. Future network activities should have a stronger focus on faculty and staff development activities.

In each of the networks in which TSU has participated, there have been numerous short courses and short workshops. A very large portion of these workshops were designed with some specialized interest. All of the workshops were rated as excellent, but an examination of our current in-house staff capabilities has revealed that there is very little residual from the short workshops. On the other hand, those members of the TSU family who were free to get involved in computer education teaching and learning activities for eight or more hours a day for four to six weeks have emerged as significant contributors to our computer education

component. If a staff member has had his original computer education indoctrination, then short workships are good. But for institutions that are in their "start-up" phase more intensive and extensive training is required.

Recommendation 4. It is recommended that extreme care be given to the scope of future network activities and that once a determination has been made, careful consideration should be given to where local access devices will be placed so as to support the attainment of the goals.

At TSU, the aims of the SRECN involvements were set as an all-university activity. Because of the central personnel involved and the expressed concerns of certain staff members the access devices were placed in the area of the mathematics department. This was not a good decision as evidenced by the development of computer related activities in other areas. For example, staff members from the School of Technology, the School of Business, the social sciences, and other areas that are stationed at remote positions from the mathematics department did not realize their expressed usage expectations because of the inconvenience of getting to the equipment. The terminals, though few in numbers, should have been widely distributed over the campus or the activity should have been centralized in a few departments or maybe one school. We also made the mistake of placing the terminals in an otherwise badly needed classroom.

FUTURE PLANS

At the present time, there is an expressed desire from such areas as the social sciences, education, business, physical sciences, technology, home economics, pharmacy, law, the Graduate School, and most importantly the administration for more and better personnel and equipment for further development of the usages of computer in our various instructional programs. Future plans include such developments as the following:

(1) An undergraduate computer science programs as soon as possible.

(2) In the School of Business there is a need to have the capabilities to simulate large games, to use COBOL, to work with large collections of data and to use large linear programming models and other mathematical techniques. The School considers such capabilities as being essential to the training of its accreditation.

(3) The School of Technology is interested in computer usages in technology including a training program for future computer hardware servicemen.

(4) The biology, physics and chemistry departments need statistical packages and they are interested in the use of modelling systems to study life, social, physical and educational situations.

(5) The Mathematics Department has interest in usages which cover programs ranging from liberal arts students computer orientation and hands-on experiences to very sophisticated numerical techniques including applied mathematics and logic.

(6) The Home Economics Department is interested in linear programming and other applications.

(7) The total University is presently in the transition from a conventional university to one that may be characterized as an urban university. It is not clear at this time what the computer related implications are to be, but we are sure that computers will play important roles in our urban thrust programs. For example, we have already recognized that if we are to have meaningful programs for a variety of people representing various social, economic, educational etc., backgrounds, we automatically have a tremendous management problem. We hope to use computers to solve the management problems.

The above represents only a brief and incomplete overview of our anticipated computer involvements. No mention is made of the administration's needs and the computer usages that will be required for the future decision making processes.

Now that we have identified approximately 50 permanent staff members who are interested in using computers in their instructional programs and many course outlines have been revised to require computer usage and many students requesting more courses and opportunities to learn, how do we supply the required hardware, software and technical assistance? That is, how do we get more terminals or other types of entry devices; how do we get more speed; more materials; more assistance for students and faculty; how do we get a shifting of administrative usages to make more prime time for students on our campus equipment; and how do we attain or train more faculty members to use computers. In other words, how do we get more money?